Global Fishing Watch

A Comparative Analysis of AIS Data with the Indian Ocean Tuna Commission Reported Transshipment Activity in 2019

2019 AIS-Detected Transshipment Activity in Tuna Regional Fisheries Management Organizations

Transshipment of catch at-sea is an important part of the global fishing industry, particularly the tuna sector. However, existing regulatory framework and implementation of monitoring methods over transshipment at-sea are widely considered insufficient, without 100% guarantee that all transfers are being reported or observed in accordance with Regional Fisheries Management Organizations (RFMOs) Conservation and Management Measures (CMMs). Ineffective and/or incomplete monitoring, control and surveillance of at-sea transshipment creates opportunities for illegally caught seafood to enter the supply chain, and more widely may perpetuate human rights abuses aboard vessels and provide an enabling environment for other illicit activities.

To help increase the transparency and understanding of at-sea transshipment activities, Global Fishing Watch (GFW), in partnership with The Pew Charitable Trusts (Pew), is undertaking an assessment of at-sea transshipment activities occurring inside the Convention Areas of the five global tuna RFMOs. Together, GFW and Pew also launched the Carrier Vessel Portal (CVP) in 2020. The first of its kind, the CVP is a publicly facing tool focused on at-sea transshipment, that seeks to provide policymakers, authorities, fleet operators, and other fisheries stakeholders information on when and where at-sea transshipment activities are taking place. The CVP uses commercially available satellite Automatic Identification System (AIS) data, combined with machine learning technology and publicly available information provided by RFMO's, including registry data, to identify and display information on potential transshipment activity.

Utilizing the CVP, Pew and GFW are producing a series of annual reports that compare at-sea transshipment-related activities observable through AIS data with publicly available information generated from RFMO member implementation of the relevant at-sea transshipment CMM. These reports are designed to be RFMO-specific and cover calendar years 2017-2019 inclusive.

These reports assess the activity of carrier vessels and indicate possible transshipment events by comparing AIS data of vessels and determining possible "encounters" and "loitering" events. 'Encounter Events' are identified when AIS data indicates that two vessels may have conducted a transshipment, based on the distance between the two vessels and vessel speeds. 'Loitering Events' are identified when a single carrier vessel exhibits behavior consistent with encountering another vessel at-sea, but no second vessel is visible on AIS, also known as a 'dark vessel'. Loitering events are estimated using AIS data to determine vessel speed, duration at a slow speed and distance from shore.

Note: AIS data is only one dataset and additional information available to RFMO Secretariats, RFMO members, and flag States is needed to provide a complete understanding of any apparent non-compliant or unauthorized fishing activity identified within this report. Only after investigation by the Secretariat or relevant flag and coastal State authorities should that determination be made and appropriate enforcement or regulatory action taken.

For more information on the data used in this study, or to request the detailed data annex, please contact carrier-vessel-portal-support@globalfishingwatch.org.

Acknowledgements

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Prepared by: Global Fishing Watch

Contents

List of Acronyms

AIS – Automatic Identification System
CAPFISH – Capricorn Fisheries Monitoring
CCSBT – Commission for the Conservation of Southern Bluefin Tuna
CMM – Conservation and Management Measure
CNCP – Cooperating non-contracting party
CPC – Contracting and Cooperating Non-Contracting Parties[1]
CVP – Carrier Vessel Portal
DPE – Designated Port for Entry
EEZ – Exclusive Economic Zone
FFA - Forum Fisheries Agency
GFW – Global Fishing Watch
ICCAT - International Commission for the Conservation of Atlantic Tunas
IOTC – Indian Ocean Tuna Commission
IUU – Illegal, Unreported, Unregulated
LSTLV – Large-Scale Tuna Longline Vessels
MCS – Monitoring, Control and Surveillance
MRAG – Marine Resources Assessment Group
PSMA – Port State Measures Agreement
RFMO – Regional Fisheries Management Organization
ROP – Regional Observer Program
SBT – Southern Bluefin Tuna
SIOFA – Southern Indian Ocean Fisheries Agreement
VMS – Vessel Monitoring System
WCPFC - Western and Central Pacific Fisheries Commission
WPICMM – Working Party on the Implementation of Conservation and Management Measures

This report also refers to UN ISO 3166-1 alpha-3 country codes which can be found here for reference https://unstats.un.org/unsd/tradekb/knowledgebase/country-code.

[1] IOTC terminology has been used to define member status in this report. Members and CNCPs are defined here: (https://iotc.org/about-iotc/structure-commission). Taiwan is defined as an invited expert using the IOTC meeting terminology (https://www.iotc.org/about-iotc/observers-iotc-meetings). Non-members are those flag States that do not participate in the IOTC.

Executive Summary

Transshipment in the Indian Ocean Tuna Commission (IOTC) Area of Competence[2] (hereinafter referred to as the "IOTC Area") is currently regulated by Resolution 19/06 *on Establishing a Programme for Transhipment by Large-Scale Fishing Vessels.* This Resolution includes reporting requirements for both fishing and carrier vessels to help deter Illegal, Unreported, and Unregulated (IUU) fishing activities and better manage the fishery. Additionally, the Resolution requires all carriers transshipping IOTC-managed species to be authorized and to carry an IOTC Regional Observer Programme (ROP) observer on board at all times. The Resolution acknowledges the need for greater monitoring, control and surveillance of vessel activity and transshipments due to '*…grave concern that... a significant amount of catches by IUU fishing vessels have been transshipped under the names of duly licensed fishing vessels…*'. Although reported transshipments decreased slightly in 2019 from 2018, they have increased 87% between 2014 and 2019[3].

In 2019, Global Fishing Watch (GFW) submitted a report[4] to the IOTC Working Party on the Implementation of Conservation and Management Measures (WPICMM) in which commercially available automatic identification system (AIS) data was used to analyze the track histories of carrier vessels operating within the IOTC Area during calendar year 2017. In 2020, a follow up analysis of data covering the calendar year of 2018 was completed and the resulting report was submitted at the IOTC Compliance Committee[5]. This year, GFW analyzed 2019 potential transshipments and port visits over time by fleet and provided an enhanced comparison of AIS activity with ROP data after the IOTC Secretariat provided carrier deployment data for further analysis.

Activity Overview

GFW detected 666 potential transshipments in the IOTC Area in 2019, nearly all of which were conducted by carriers in areas of overlapping management with other RFMOs, including CCSBT and SIOFA. In addition, 35% of the potential transshipments were conducted by carriers flagged to non-CPCs. Countries which are not members or cooperating non-members of IOTC are not required to comply with IOTC Recommendations and Resolutions, which is a potential risk to effective management within the IOTC Area. Increased use of monitoring, control, and surveillance (MCS) tools – like a centralized VMS program, information sharing agreements with other RFMOs, and greater uptake of Class A AIS – can support enforcement and compliance efforts to reduce this risk.

[2] Details of the IOTC Area and species of competence here https://iotc.org/about-iotc/competence
[3] See page 5 IOTC-2020-CoC17-04a_E_-_Report_on_Transhipments.pdf
[4] https://globalfishingwatch.org/rfmo-transshipment/
[5] See *Information Papers* https://iotc.org/meetings/17th-session-compliance-committee

Comparison of ROP Deployments to AIS Data

The Carrier Vessel Portal (CVP) matched 91.3% of all reported carrier vessel deployments documented in the 2019 ROP Report to AIS data. An additional 21 trips were detected of carrier vessels operating in the IOTC Area which were not matched to ROP observer reported deployments. 43% of those unmatched trips were by non-CPC flagged carriers. In addition to the need for a centralized shared VMS system for IOTC Members, mandated use of AIS data by all vessels operating in the area can be used to supplement ROP reported data to help ensure compliance with IOTC Resolution 19/06. Lastly, transshipment data reported in a more consistent, timely and detailed manner, including data such as the vessel's identity, geo-location and date when transshipments have been authorized, will allow for better cross-comparison of data sources to ensure compliance.

Port Activity

Nearly half (44%) of all port visits by carrier vessels after an AIS detected encounter in the IOTC Area were not designated for entry under IOTC Resolution 16/11 on Port State Measures. Notably, six of the port visits to non-designated ports were conducted by non-CPC flagged carriers that were not matched with ROP deployment data. To ensure effective management of IOTC-caught species, compliance to IOTC management procedures must be observed both at-sea and in port. Carriers visiting ports in non-CPCs, or States which are party to the PSMA increase the risk that IOTC-managed catch will either go uninspected or be subjected to weaker inspection standards than required by IOTC Resolution 16/11.

Finding	Recommendations for IOTC
High levels of carrier activity were observed in areas overlapping with other RFMOs which manage non-IOTC species. 35% of the AIS detected transshipments were conducted by carriers flagged to non-CPCs, including additional more potential activity by non-CPCs than reported by the ROP.	Ensure strong information-sharing agreements with CCSBT, SIOFA and flag States of the squid fishery in North West Indian Ocean. Require that only CPCs and invited experts are authorized to transship with CPC LSTLVs and that all subsequent transshipments within the IOTC Area by these vessels are covered by the ROP.
The CVP captured 91% of all ROP reported carrier deployments in 2019 but identified only around 50% of the reported transshipments due to deliberately conservative analytical matching. The CVP also identified 21 trips not matched to ROP data. 43% of these unmatched trips were conducted by non-CPC flagged vessels.	Prioritize creating a centralized shared VMS system for IOTC Members with access by the Secretariat Compliance team. As a complement to a VMS program, encourage the use of class A AIS on all vessels transshipping IOTC managed species. Make information relating to transshipment activity, such as the location, duration and time of authorized events, publicly available through the ROP reports
44% of the ports visited by carriers were not listed as a designated port of entry, either under IOTC or under the FAO PSMA. AIS detected 6 port visits by non-CPC carriers to ports not designated for entry under IOTC or the PSMA and not matched to ROP deployment data.	Update the list of designated ports established in support of CMM 16/11 to also include ports designated by CPCs outside the IOTC area of competence in the spirit of Article 20 of the resolution. Encourage CPCs to ensure vessels carrying IOTC-managed products use ports designated under Resolution 16/11 or if that is not possible, ports designated under PSMA.

1 Activity Overview

At sea transshipment in the IOTC Area is regulated by IOTC Resolution 19/06,. The Resolution requires Contracting Parties and Cooperating Non-Contracting Parties (CPCs) to ensure that all reporting requirements for carrier vessels which transship with large-scale tuna longline vessels (LSTLVs) are met. This includes the requirement to have an observer from the Regional Observer Program (ROP) onboard, who shall report all transshipments by the carrier vessel to the IOTC Secretariat in the annual ROP report. The 2019 IOTC Regional Observer Programme (ROP) Report from Marine Resources Assessment Group (MRAG) and Capricorn Fisheries Monitoring (CAPFISH) recorded 1,317[6] ROP monitored transshipment events between a total of 28 carrier vessels and the large-scale tuna longline fishing vessels (LSTLVs) within the IOTC Area.

The IOTC shares responsibilities of management of the waters with the Commission for the Conservation for Southern Bluefin Tuna (CCSBT) and the Southern Indian Ocean Fisheries Agreement (SIOFA), which manages a large diversity of fish species[7] . Overall, 43% of the potential events detected through AIS occurred in the overlap area between all three RFMOs. Additionally, in the North West Indian Ocean there is a transshipment hotspot linked to an unregulated squid fishery. To ensure effective management of its stocks, it is essential that IOTC has a robust and transparent information exchange program with the other RFMOs and ideally with the key flag States of the unregulated squid fishery in the North West, the fleet of which is predominantly from one of the IOTCs CPCs. GFW experience with other RFMOs suggests that if more detailed geolocation data was included in the ROP reports, checking for compliance would be both simplified and more robust and it is recommended that data be included in future.

This study does not analyze any transshipments in the Indian Ocean north of 12 degrees North as it was assessed they were predominantly associated with the squid fishery and significantly less likely to include RFMO managed species. Given the multiple RFMO responsibilities for these waters, independent verification the IOTC ROP reports is challenging but the spatial distribution of likely transshipment activity in the area is clear, although not necessarily which stocks of the three RFMOs was being transferred at each event. The spatial distribution of GFW detected potential transshipment events is shown below (Figure 1).

[6] See page 5 of IOTC-2020-CoC17-04b_E_-_IOTC_ROP_Contractor.pdf

[7] SIOFA managed species are frequently landed in the western pocket of the IOTC-CCSBT overlap, defined as the portion of IOTC below -20 degrees latitude and 55 degrees longitude. For further information on this overlap area, see last year's 2018 IOTC Transshipment Report.

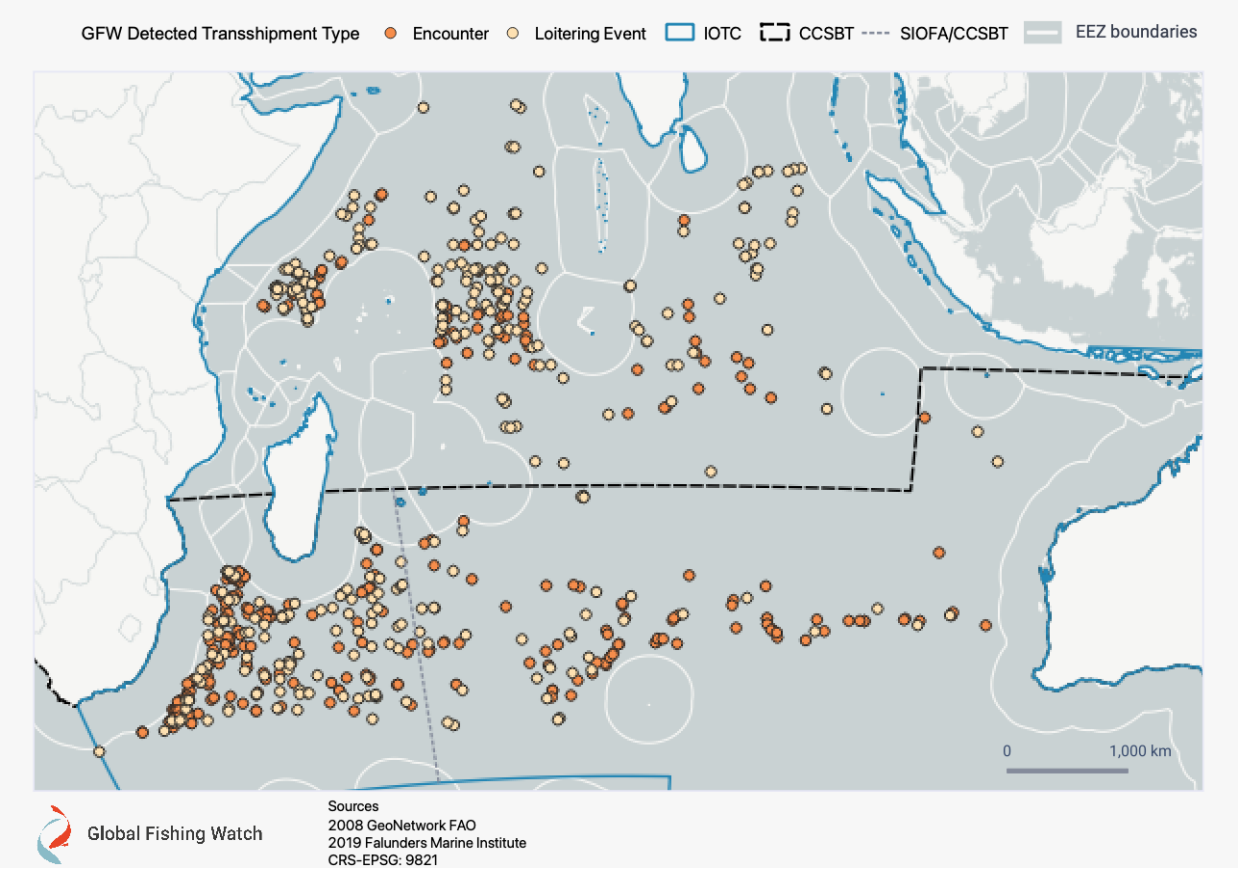

Figure 1. GFW detected encounter and loitering events in the IOTC Area in 2019

Carrier vessels flagged to Fishing Entity of Taiwan, (henceforth "Taiwan")[8] comprised the largest portion of ROP reported transshipment deployments. The remaining transshipments were conducted by vessels flagged to Liberia, Malaysia, Panama, the Republic of Korea (henceforth "Korea"), Japan, and Singapore (Figure 2A). China was the only country that reported carrier activity in 2018 but did not report continued transshipment activity in 2019.

[8] This report follows the same naming convention as IOTC for members, cooperating non-contracting parties, non-members and invited experts.

GFW AIS-based data identified 666 potential transshipments connected to 98 total trips[9], representing activity in the IOTC Area between port visits that included encounter and/or loitering events (Figure 2B). These trips were conducted by 39 carrier vessels from 12 different flag States. When looking at just encounters, GFW identified 341 events by 23 carrier vessels from 7 flag States. The highest volume of encounters was detected by carriers flagged to Taiwan (189 encounters) followed by carriers flagged to Panama (62 encounters) and Singapore (50 encounters). Of the potential transshipments detected on AIS, 35% were conducted by carriers flagged to non-CPCs (primarily Panama & Singapore).

Variation in trip counts between the ROP reported deployments and AIS observed trips (Figure 2) is due to different assessment criteria. An AIS trip is any voyage between two ports with activity inside the IOTC area, a ROP observer deployment may cover multiple port stops so the two counts will not always match. The comparison section below provides more detail on AIS observed trips including those that did not overlap with ROP reported observer deployments.

[9] GFW defined trips do not necessarily equate to ROP deployments as a single ROP authorized deployment could encompass multiple GFW 'trips' if more than one port visit occurred during the same deployment. See Annex 1 for more information on how GFW defines trips and port visits.

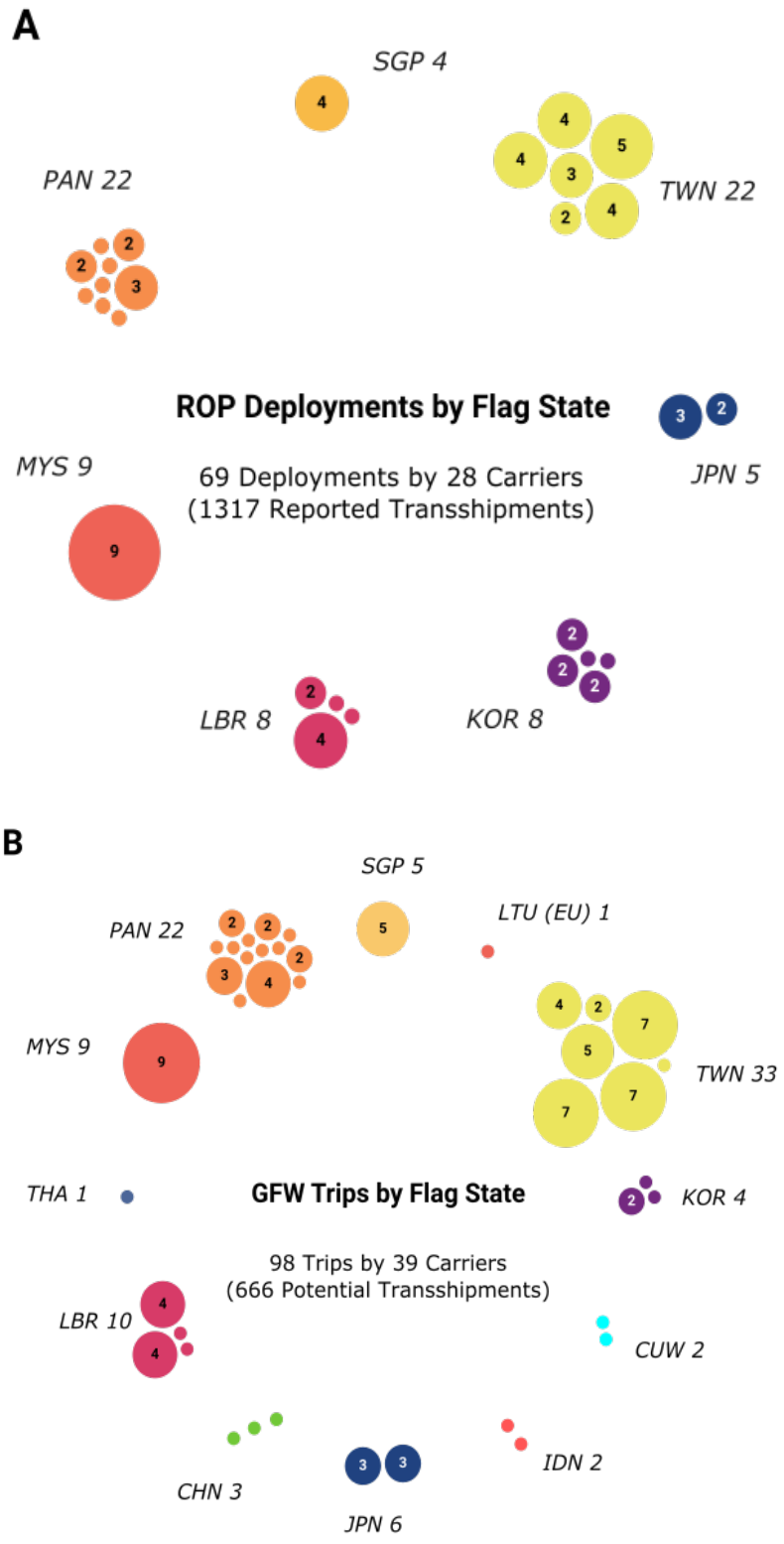

Figure 2. A. Reported Transshipments by Carrier Flag State. B. GFW AIS-Detected Potential Transshipments by Carrier Flag State. Note: bubbles indicate unique carrier vessels

2 Comparison of ROP Deployments to AIS Data

In last year's (2018) transshipment report, the IOTC ROP 2018 Summary Report and the IOTC 2018 Secretariat's Report were compared to GFW's AIS data. Both of these reports are made publicly available by IOTC and include information on the number of authorized ROP deployments, as well as the number of observed transshipments during the given calendar year. These public Summary Reports do not include geolocation or timestamps of the observed transshipment activity, nor does it provide deployment level summary details such as total number of transshipments on each deployment. This lack of detail in the IOTC transshipment reporting makes direct comparisons between the public IOTC data and secondary data sources like AIS difficult.

Following a request made by Pew and GFW in 2020, the IOTC Secretariat provided 2019 ROP observer deployment data, including vessel name, IMO, callsign, and flag State information, as well as observer deployment start and end dates and port visits, and information on when and where the ROP observer boarded and disembarked. This information allows for a more effective comparison between the ROP and AIS data. Here forward, we refer to ROP authorized trips as 'ROP deployments' and AIS detected trips as 'trips'.

Using the additional ROP deployment data supplied by IOTC Secretariat GFW was able to match the ROP deployments with carrier vessel AIS tracks. Although this does not allow for a direct comparison at the transshipment event level it does mean GFW detected encounter and loitering events can be linked to trips where a carrier had an observer onboard or not, at the time of the event.

The matching process creates three categories of carrier trips within the IOTC Area:

1. Observable on AIS and reported by the ROP
2. Reported by the ROP but not observable on AIS
3. Observable on AIS but not reported by the ROP

2.1 Observable on AIS and reported by the ROP

Data provided by IOTC outlined 69 carrier vessel deployments with an IOTC observer onboard in 2019; 66[10] deployments which were authorized in 2019 and 3 deployments which were authorized in 2018 but included activity dates in 2019.

Of the 69 deployments reported by IOTC that occurred in some portion of 2019, GFW matched 91.3% (63) of ROP-reported deployments to AIS based trips (see Annex 1) used for this report.

[10] One deployment authorized in 2019 was considered cancelled for the purpose of the 2019 ROP reports (Secretariat's and Contractor's reports). We included this deployment in our analysis as an ROP observer was on board, however this deployment is not reflected in the 2019 Report on Transshipment, which records 65 authorized ROP deployments in 2019.

2.2 Reported by the ROP but not observable on AIS

Six ROP deployments could not be matched to AIS transshipment activity in 2019 in the IOTC Area. Two of the deployments started in 2018 and finished in 2019 however all the transshipments occurred in 2018 outside the analysis period of this report.

Four ROP authorized deployments with reported transshipments in 2019 not detected on GFW's CVP were all flagged to Korean carriers (four trips by three unique carriers). The carriers connected to these deployments did not appear on AIS at all during their authorized deployment, although they did appear on AIS during other periods of 2019. The same three carrier vessels were also associated with ROP authorized deployments in 2018 which did not appear on AIS for any portion of the authorized deployment. While it is unclear why the Korean carriers did not appear on AIS, it is worth noting that intentional AIS disabling by vessels of this size is unusual and would likely be considered in contravention of SOLAS Chapter V, Regulation 19[11].

2.3 Observable on AIS but not reported by the ROP

GFW identified 21 carrier vessel trips linked to 33 potential transshipments (2 encounters and 31 loitering events) that were within the IOTC Area but were not matched to ROP deployment data (Table 1). Carriers flagged to Panama, not an IOTC Member, appeared with the most unmatched potential transshipment activity (all loitering events) with 33% of unmatched potential transshipment events. See Annex 2 for further trip details on AIS identified trips that were not reported by the ROP.

Table 1. Carrier Trips Identified on AIS Not Matched to ROP Deployments in 2019

Carrier Flag	Unique Carriers	GFW Trip Count	GFW Encounters	GFW Loitering Events
China	3	3	0	3
Curacao**	2	2	0	4
Indonesia	2	2	0	2
Japan	1	1	0	2
Liberia	1	2	2	2
Lithuania	1	1	0	1
Panama**	6	7	0	11

[11] https://www.liscr.com/sites/default/files/SOLAS%20V_Reg19.pdf

Thailand	1	1	0	2
Taiwan	2	2	0	4
Total	**19**	**21**	**2**	**31**

**** = non-CPC**

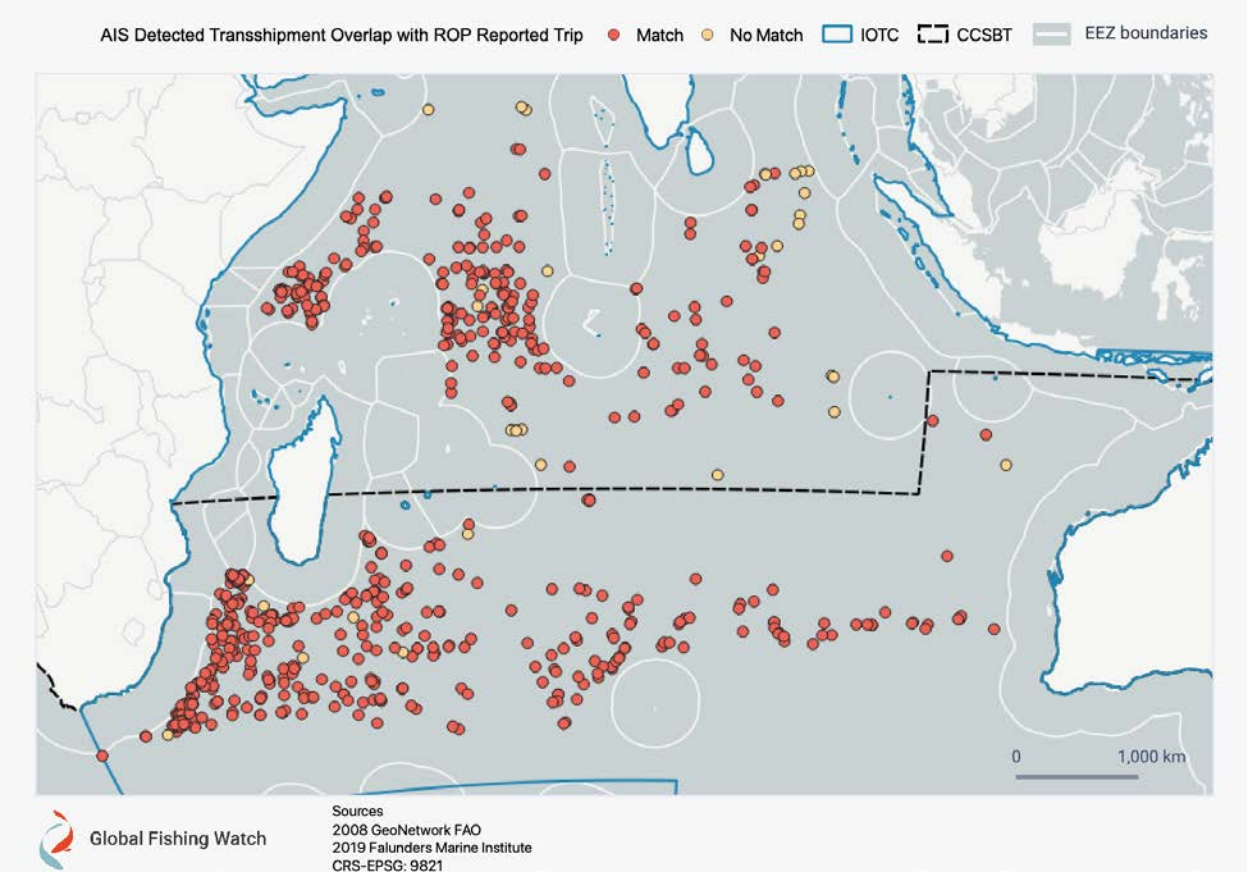

Figure 3. All potential transshipment events colored by if event overlapped with ROP deployment.

The two unmatched encounters, not identified in the data provided by the IOTC Secretariat, occurred in the Western portion of the IOTC-CCSBT overlap area and were both linked to a Liberian carrier authorized by IOTC and CCSBT. Both encounters occurred on the high seas with two different LSTLVs that had both been fishing inside the Madagascar EEZ prior to the

encounter. In addition, the same Liberian carrier also engaged in two ROP authorized deployments and was reported as an active carrier in 2019[12] with reported Southern Bluefin tuna transshipments, a stock managed by CCSBT[13].

Figure 4. An encounter observed on AIS between a Liberian carrier on route to Port Louis and an LSTLV after apparent fishing activity inside the Madagascar EEZ. The carrier was not reported as having an observer deployment at this time.

GFW also identified AIS observed trips with loitering events inside the IOTC Area that did not match to ROP-reported deployments, including trips by CPC vessels (Liberia, Lithuania (EU), China, Indonesia, Japan, Thailand, and Taiwan) and non-CPC vessels (Curacao, and Panama). CPC flag States accounted for 57.1% (12 trips) of unmatched trips and non-CPC States accounting for 42.9% (9 trips) of unmatched trips. Carriers flagged to Panama, which is not a member of IOTC, accounted for 7 of these trips.

[12] See page 3 IOTC-2020-CoC17-04a_E_-_Report_on_Transhipments.pdf
[13] See page 10 IOTC-2020-CoC17-04b_E_-_IOTC_ROP_Contractor.pdf

While loitering events can be indicative of potential transshipment activity with fishing vessels not on AIS, loitering can also be a result of activity other than transshipments including mechanical issues or a vessel awaiting information on its next destination. The behavior of a vessel in between AIS observed loitering events can be an indicator of the likelihood the vessel transshipped. For instance, some of the AIS observed trips not matched to the ROP reported deployments included just one loitering event in a vessel's direct transit across the IOTC Area, indicating a low likelihood for a transshipment (figure 5).

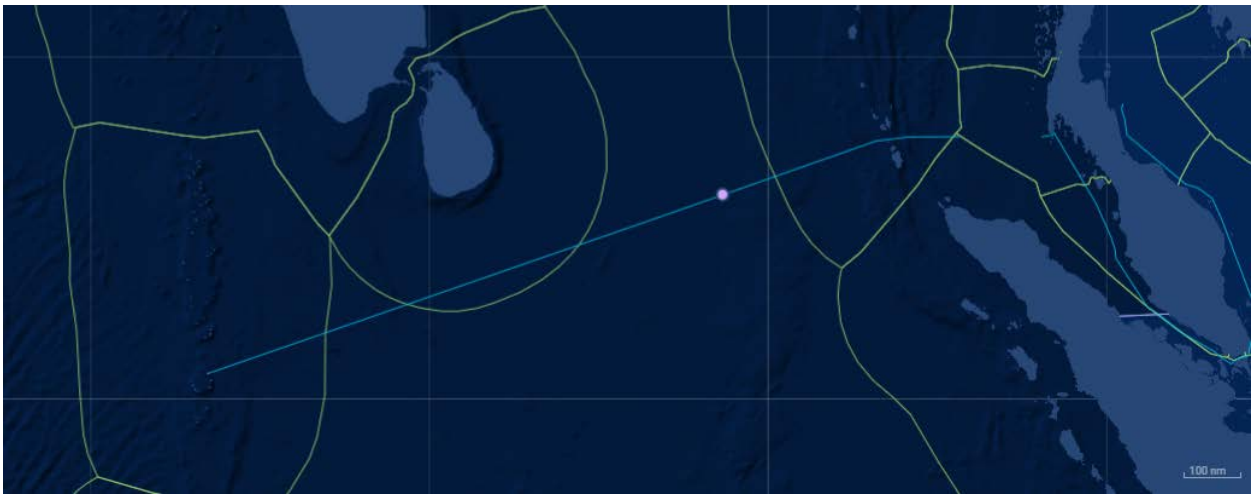

Figure 5. An AIS observed trip inside the IOTC Area by a Thai carrier with a single loitering event (purple point) that is unlikely to indicate a transshipment of fish not match any ROP reported deployments

In contrast some of the vessels had multiple loitering events with significant course changes in between the events – behavior consistent with transshipment activity (Figure 6). For a full list of AIS trips with detected transshipments not matched to ROP deployment data in the IOTC in 2019, see Annex 2.

Figure 6. An AIS observed trip inside the IOTC Area by a Taiwanese carrier with multiple loitering events (purple points) and behavior consistent with transshipment activity (in contrast to a vessel transiting the zone) not match any ROP reported deployments. The AIS analysis does not evidence a transshipment took place however it can provide effective guidance to the relevant competent authorities to investigate further where necessary.

Two findings stand out from this comparison of AIS data with the ROP deployment data provided by IOTC. Firstly, the successful detection rate of transshipments reported by the ROP in the IOTC area in 2019 by GFW using AIS data was relatively low compared to other RFMO areas. In 2019 GFW detected close to 50% of the IOTC ROP reported transshipments compared to similar studies in 2018 that detected up to 80% of Western & Central Pacific Fisheries Commission (WCPFC) ROP reported transshipments and detected 68% of transshipments reported by the International Commission for the Conservation of Atlantic Tunas (ICCAT) ROP. The factors that affect the detection rates are related to the low levels of AIS use

by fishing vessels in the Indian Ocean compared to other tuna RFMO areas[14], and the conservative nature of how potential transshipments are identified by GFW models (Annex 1 Data caveats). Transshipment detection algorithms are being improved upon all the time and increased use of AIS by the fishing fleets would improve performance in the IOTC Area. Increased AIS use can be achieved through flag States strengthening AIS regulation for their fishing fleets, either regionally through IOTC CCMs agreed by the members, as is the case in the Forum Fisheries Agency (FFA) Good Standing[15] or at the national level as is the case of the European Union members, United States and Canada, who regulate AIS use for their fishing vessels operating beyond national waters.

The second finding is that 95% of the AIS observed potential transshipments matched ROP reported observer deployments, indicating that the majority of encounters between LSTLVs and carrier vessels are carried out within the ROP framework. The remaining 5% of activity (33 potential transshipments) identified through AIS analysis would be difficult to monitor using the current IOTC VMS CCM which does not benefit from a centralized system. AIS analysis has been shown to complement the use of VMS as a tool for monitoring transshipment activity in the IOTC region. Furthermore, the accuracy of AIS data as a monitoring tool is expected to continue to increase as the technology improves and developments like the GFW Carrier Vessel Portal[16] allows open access to the data.

IOTC CPCs can play a central role in strengthening transshipment monitoring by reporting the geolocated data on all authorized transshipments. The secretariat can support the uptake of AIS based analysis for transshipment monitoring by its members through its capacity building and training programs. Finally, these reports are done on a historic basis due to the reporting timeline of ROP data, if IOTC reported the geolocated data on authorized transshipments in a timely manner, the analysis could be done in more detail, identifying any potentially falsely reported transshipment declarations as well as potential unreported activity while vessels were still at sea, thus facilitating investigations during port control procedures by IOTC CPCs and PSMA ports.

[14] In part due to piracy issues over the last 20 years, further details can be found in Taconet, M., Kroodsma, D., & Fernandes, J.A. (2019). Global Atlas of AIS-based fishing activity - Challenges and opportunities. Rome, FAO. http://www.fao.org/documents/card/en/c/ca7012en

[15] Guide to application for registration and good standing on the FFA vessel register (2019). Director-General Pacific Islands Forum Fisheries Agency. Section 3.1

[16] https://globalfishingwatch.org/carrier-portal

3 Port Activity

IOTC Resolution 16/11 on Port State Measures[17] regulates port access and use. It is a comprehensive port State management measure, consistent with the FAO Port State Measures Agreement (PSMA). As the IOTC Conservation and Management Measure is so well aligned with PSMA, risks associated with carrier vessel visits to designated ports within the IOTC Area should be negligible, however this does assume that the IOTC measures are fully implemented and that the relevant port State has the capacity to enforce the management arrangements. CMM 16-11 requires States to nominate ports in which IOTC managed species should be landed and that carriers should not land IOTC-managed species at a port which is not listed as an IOTC designated port of entry. Furthermore, it encourages CPCs to apply the CMM to their own ports when they lie outside the IOTC area of competence. Based on GFW analysis, it is recommended that CPCs update the list of designated ports. The current list includes submissions from late 2010 and does not reflect the major ports identified by AIS detected port activities.

The spatial distribution of the AIS-detected port visits is shown in Figure 7 below and again highlights the key role of Port Louis, Mauritius in managing and distributing IOTC catch. Similar to last year Cape Town is the other significant port for handling carrier vessels in the IOTC Area. Beyond the IOTC Area there was increased activity identified in CPC mainland ports with the similar activity observed in the non-CPC ports of Singapore and Kaohsiung. Analysis of the flag States of the carrier vessels entering all ports post likely transshipment activity of IOTC managed species indicates 83% of the visits were conducted by foreign flagged vessels and so would fall into the inspection regime required by CMM 16/11 or the PSMA.

Singapore, once again, features highly as a first port of entry following likely transshipment activity in the IOTC Area. While recorded visits are down over 50% from last year, levels are still significant. Although the IOTC CMM offers the opportunity for PSMs to be applied to any vessel carrying fish that has not yet been landed, it is assessed that this activity is relatively low risk to IOTC as Singapore is a natural port of call for bunkering en route to a final port of destination. It is considered unlikely that significant volumes of IOTC managed species are being offloaded on these visits, but this report only reflects the first port of call for any vessel. The visits to Singapore serve to highlight the importance of information exchange between countries and the role of advance entry into port reporting requirements for carrier vessels before they offload their cargo for verification purposes.

[17] https://www.iotc.org/compliance/port-state-measures

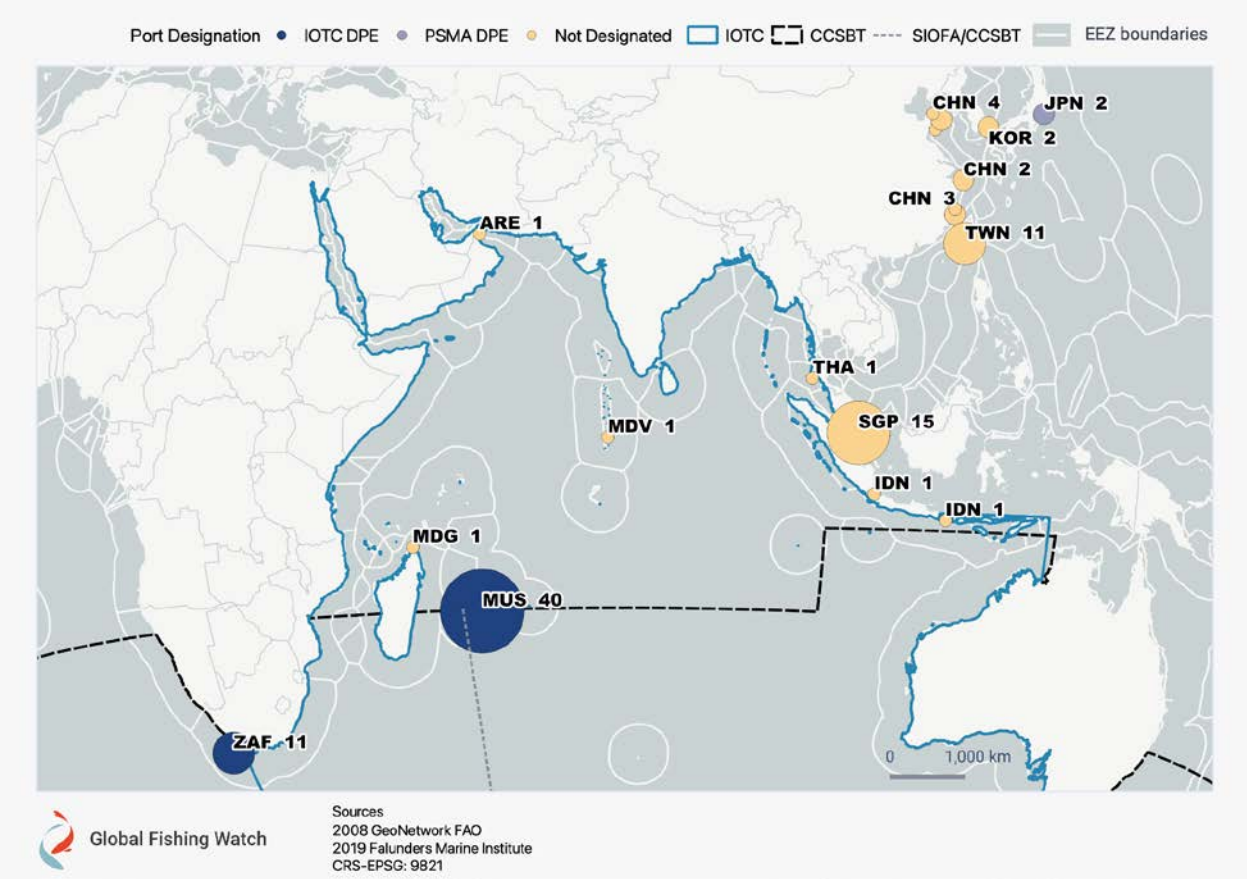

Figure 7. Count of port visits by carriers after potential transshipment events on the high seas in the IOTC Area. Port symbols are sized proportionately based on the number of port visits.[18]

[18] In addition to the 96 port visits displayed on the map are two port visits outside the bounds of the map. One port visit to Montevideo, Uruguay and one port visit to Majuro, Marshall Islands. Both ports are in States party to the PSMA although neither port is designated for entry by the PSMA.

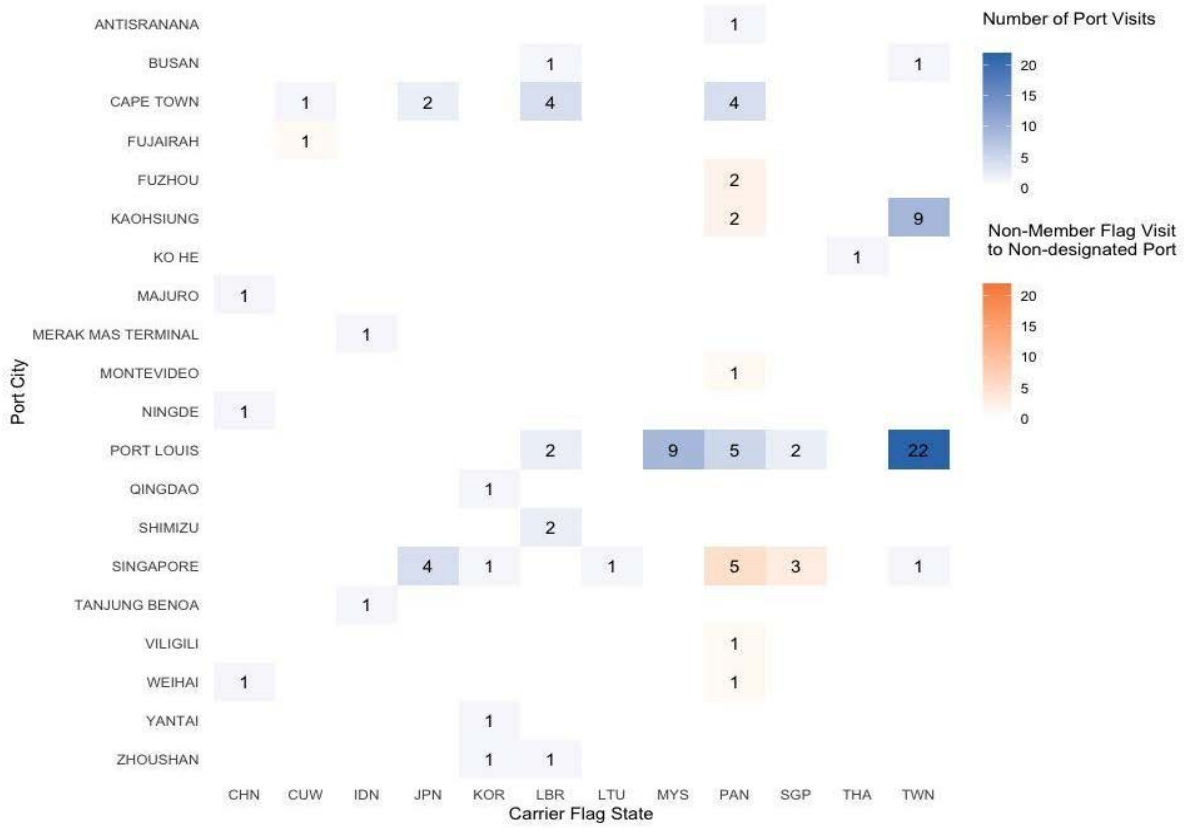

Figure 7. Port visits by carrier flag State after encounter and/or loitering events

There were 44 visits to ports not designated for landings or entry under the IOTC or PSMA. Just over one-third of these visits (16 of 44) were by non-CPC flagged carriers (Figure 6). Six of these visits occurred after activity not reflected in the ROP deployment data and so likely unobserved for IOTC species. While there is no evidence that these vessels landed fish– they may have embarked observers, crew or supplies – it represents a risk and highlights the need for robust data exchange and compliance with Resolution 19/06 and 16/11 by CPCs and relevant flag and port States.

4 Conclusion and Recommendations

This analysis highlights the complicated nature of monitoring and regulating at-sea transshipment in the IOTC Area. Transshipment activity by non-CPCs clearly has less directly mandated oversight requirements, and so increases the risk of unreported activity. Any transshipment activity not reported through the ROP, and conducted by a carrier that does not land catch at a designated port, increases the risk that potentially non-compliant behavior at-sea is not afforded an appropriate level of oversight in port. These risks should be of concern to the Commission, and could be relatively easily addressed. Transshipment activity that is not fully observed, reported, or inspected represents a significant risk of IUU product caught within the IOTC Area entering the seafood supply chain. By comparing the IOTC ROP reported activity with AIS-data in three main categories key recommendations to IOTC have been identified as follows:

Activity Overview

Findings:

- There is a consistent temporal and spatial overlap of at-sea transshipment activity by carrier vessels in the rich fishing areas overlapping with CCSBT and, SIOFA and an unregulated squid fishery to the North West of the area. This finding was reviewed in detail in last year's report, and presents a challenge in assessing overall activity and compliance.

Recommendations:

- Strengthen information-sharing agreements with CCSBT and SIOFA to ensure accurate reporting and transshipment of catch in all three RFMOs.
- Include geolocation data on transshipment events within ROP reports.
- Prioritize creating a centralized shared VMS system for IOTC Members with access by the Secretariat Compliance team.

Comparison of ROP Deployments to AIS Data

Findings:

- AIS data in the Carrier Vessel Portal (CVP) matched 91% of all carrier vessel deployments documented in the ROP in 2019.
- AIS observed vessel activity identified 21 trips by carrier vessels in the IOTC Area not matched to ROP reported deployments, 43% of these were conducted by non-CPC flagged carriers. These findings suggest the risk of transshipments of IOTC species within the IOTC Area happen outside of IOTC Resolution 19/06.

- 35% of AIS-detected potential transshipments in the IOTC Area were conducted by carrier vessels flagged to non-CPCs, namely Panama and Singapore. While both countries had carriers included in ROP, AIS data detected more trips by carriers flagged to these countries than were included in the observer reports.

Recommendations:

- Supplement the use of VMS by Members by encouraging the use of class-A AIS by vessels authorized to fish or transship in IOTC. This would help promote vessel safety whilst increasing the proportion of transshipment activity observable by AIS within the IOTC Area (noting any AIS regulations should follow Resolution A.1106(29) and latest antipiracy guidance for the Indian Ocean).

- Increase transparency of transshipments by making publicly available, in a timescale without prejudice for implementing effective MCS, the reported carrier activity to the IOTC Secretariat, including the vessel's identity, geo-location and date. Ensure that only vessels flagged to CPCs and invited experts are authorized to transship with CPC LSTLVs and that all subsequent transshipments by these vessels within the IOTC Area are covered by the ROP. Additionally, require carrier vessels to provide a “supplying declaration” when conducting supplying activities without an ROP onboard, similar to the requirement included in the new ICCAT Recommendation on Transshipment (Rec. 21-15).

Port Activity

Findings:

- Resolution 16/11 is well aligned with the requirements of FAOs PSMA, but the list of designated ports under the resolution is out of date.

- The presence of both observed and unobserved non-CPC carrier activity in the area of competence presents a management risk. For example, six port visits were conducted by non-CPC flagged vessels following unobserved (by IOTC observers) encounters and/or loitering events. None of the ports are? designated for entry through the PSMA or through IOTC Resolution 16/11.

Recommendations:

- Update the list of designated ports established in support of CMM 16/11 to also include ports designated by CPCs outside the IOTC area of competence in the spirit of Article 20 of the resolution.

- Effectively implement Resolution 19/06 by ensuring all carriers carrying IOTC managed species land catch from the IOTC Area in ports designated under Resolution 16/11.

- Encourage CPCs to ensure vessels carrying IOTC-managed products use ports designated under Resolution 16/11 or if that is not possible, ports designated under PSMA

Sources

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Annex 1. Detailed Methodology

AIS-based data methods

Carriers registered over 300 gross tons and on international voyages are already required to broadcast on Automatic Identification System (AIS), as mandated by the International Maritime Organization (IMO) (IMO 2015). Although the use of AIS is not globally mandated for fishing vessels, AIS used in fishing fleets is increasing with a growing number of flag and coastal States mandating its use through their own national or regional fisheries regulations. AIS devices broadcast the location of a vessel along with other information, including identity, course and speed. This makes the use of AIS, and its subsequent analysis, very useful in understanding fishing activity that can be used to support and complement existing national and RFMO Monitoring, Control and Surveillance (MCS) programs. This is especially true as AIS can provide a greater insight of fishing vessel activities, especially when these interactions involve vessels of differing flag States where VMS data is not publicly available or readily shared between authorities.

The Carrier Vessel Portal (CVP) is established using GFW datasets developed from AIS data. The CVP uses the same datasets used in the 2019 transshipment reports (https://globalfishingwatch.org/rfmo-transshipment/), including possible transshipment events defined as encounter and loitering events, port visits by carrier vessels, vessel identity information broadcast from AIS, and publicly available vessel registry data. While datasets used in this report match the CVP, this analysis added a number of additional constraints to the potential transshipment events analyzed (geographic area of interest, minimum and maximum restrictions on loitering events) and thus the CVP data must be filtered to match these constraints.

GFW uses publicly broadcasted AIS data to estimate vessel information and vessel activity, including fishing, encounters and loitering events. Encounters, where two vessels meet at-sea, may indicate possible transshipment activity between two vessels. Vessel encounters are defined when two vessels are within 500 meters of each other for at least 2 hours and traveling at < 2 knots, while at least 10 kilometers from a coastal anchorage (Miller et al. 2018). Whereas, vessel loitering is when a carrier vessel travelled at speeds of < 2 knots for at least 4 hours, while at least 20 nautical miles from shore (see Miller et al. 2018 for original methodology, however the original minimum of 8 hours has been changed to 4 hours for the purposes of this study).

Loitering by a single carrier vessel where the carrier vessel exhibits behavior consistent with encountering another vessel at-sea, but no second vessel is visible on AIS, may also indicate a possible transshipment event but where there is no AIS data for the second vessel, also known as a ‘dark vessel’ (Figure A1). Loitering events may indicate a possible encounter for which data is lacking for the second vessel, possibly due to lack of AIS transmission, poor satellite coverage, or the size of the second vessel (INTERPOL 2014).

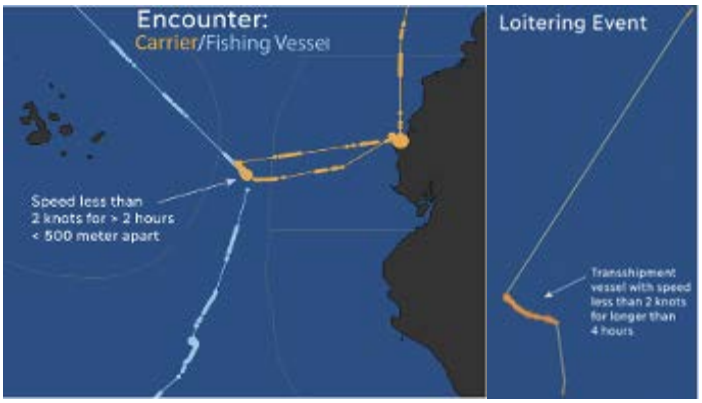

Figure A1 - Examples of vessel tracks during typical 'Encounter' where two vessels meet at-sea and 'Loitering' events where a carrier vessel (referred to as transshipment vessel) has behavior consistent with encountering an LSTLV at-sea but no LSTLV is visible on AIS

The GFW database also contains an estimate of port visits conducted by carriers. GFW defines ports as any 0.5-kilometer grid cell with 20 or more unique vessels stationary for greater than 12 hours. A port visit includes the port entry and exit of a vessel if the vessel stops. A vessel "enters" port when it is within 3 kilometers of a GFW-defined port. A vessel has 'stopped' when it has entered port and slowed to a speed of 0.2 knots and has started movement again when it moves over 0.5 knots. A vessel "exits" port when it is at least 4 kilometers away from the previously entered port. Note, for the purposes of this analysis any port visits that had a duration of less than 3 hours were removed from the data. Port stops can vary in duration from less than an hour to multiple weeks. Generally, very short port stops, as defined by GFW, may be intermediate ports a vessel stops at before entering a port to conduct activities of interest to this report, such as offloading of catch. Therefore, in an attempt to exclude intermediate ports, this analysis excluded port visits of less than 3 hours, so that all voyages ended at ports where the carrier vessels remained for at least 3 hours.

The carrier and fishing vessels analyzed in this report were chosen based on the GFW database of fishing and carriers. The fishing database is defined in Kroodsma et al. (2018) and includes fishing vessels based on registry database information or as defined by a convolutional neural network (Kroodsma et al. 2018). Fishing vessels capable of fishing tuna were defined by the GFW vessel classification using known registry information in combination with a convolutional neural network used to estimate vessel class (network described in Kroodsma et al. 2018). The carrier database is defined in Miller et al. (2018) and was curated using International Telecommunication Union and major RFMOs, vessel movement patterns based on AIS, a convolutional neural network used to estimate vessel class (see Kroodsma et al. 2018) and the International Maritime Organization (IMO) unique identifier.

For the purposes of the IOTC 2019 transshipment analysis the possible transshipment events were restricted to those most likely to be relevant for the analysis. Because the IOTC transshipment resolution focuses on LSTLVs, any encounters involving fishing vessels not

identified as longlines were removed from the analysis and loitering events that occurred >= 12 degrees latitude were removed from the analysis as well. GFW recognizes there is a risk that tuna and tuna-like species are transshipped in this region, however this is also a known area of squid-related transshipment events and not an area of reported transshipments by the IOTC (see figure 3 in *A Summary of the IOTC Regional Observer Programme During* 2019- MRAG and CapFish 2020) nor an area of identified encounters between carrier and longline vessels, and consequently may bias an IOTC focused transshipment analysis. In addition loitering events were restricted to those that are <= 24 hours in duration, due to a finding from the 2017 transshipment reports (for example see section 4.6 in the 2017 ICCAT report) that these loitering events are more likely to indicate possible transshipment activity.

Vessel authorization was established by using the publicly available vessel registry produced by IOTC[19], CCSBT[20], and Taiwan Fisheries Agency's list of IOTC authorized vessels[21]. In addition to the registry data found in the CVP, the IOTC list of Active Carriers[22] and vessels that declared transshipment of SBT[23] were used to identify those vessels that were permitted to conduct transshipment activity. If a carrier or fishing vessel was listed as 'authorized' on any of the public registries during an encounter or loitering event the event was considered 'authorized'. However, if a vessel was not authorized on one of the three registries during the time period of an encounter or loitering event the authorization status is unknown. The ability to determine vessel authorization is largely dependent on the accuracy and comprehensiveness of the public registries, as well as the vessel information (name, MMSI, IMO, callsign) transmitted on AIS by the vessel and used by GFW.

Data caveats

The analysis presented in this report relies on commercially available AIS data and publicly available information. Therefore, the AIS data is limited by those vessels that transmit AIS data and do so by providing accurate vessel identity information. Low satellite coverage or high-density areas can also limit AIS data usefulness, although the IOTC Area has relatively strong Class-A AIS reception, however AIS reception tends to be worse in the North, and may be turned off for security reasons (see Taconet, Kroodsma, and Fernandes 2019). AIS data tends to be sparser and more limited for vessels equipped with Class-B AIS devices (Kroodsma et al. 2018). Class-B AIS reception is quite poor in the northern half of the Indian Ocean basin (Taconet, Kroodsma, and Fernandes 2019). For further analysis of GFW AIS data quality in the Indian Ocean refer to: Taconet, Kroodsma, and Fernandes 2019. AIS device class often depends on flag State regulations, vessel length, and vessel purpose. Because of the limitations of AIS data, lack of complete and accurate public vessel databases and registries, and limitations of modelling estimations, the AIS detected encounter, and loitering data are represented as accurate as possible but should be considered restrained estimates based on

[19] https://www.iotc.org/vessels/date
[20] https://www.ccsbt.org/en/content/ccsbt-record-authorised-vessels
[21] https://www.fa.gov.tw/en/Record_of_Vessel/index.aspx
[22] See page 3 IOTC-2020-CoC17-04a_E_-_Report_on_Transhipments.pdf
[23] See page 10 IOTC-2020-CoC17-04b_E_-_IOTC_ROP_Contractor.pdf

these limitations (see Kroodsma et al. 2018, Miller et al. 2018, and https://globalfishingwatch.org/ for further discussion).

Annex 2. GFW Trips Unmatched to ROP Deployments

Carrier Flag	Carrier Trip Start Date	Carrier Trip End Date	Trip Duration (Days)	GFW Encounters	GFW Loitering Events
CHN	3/2/19	5/26/19	85	-	1
CHN	10/13/19	12/20/19	68	-	1
CHN	11/18/19	2/15/20	89	-	1
CUW	4/30/19	6/2/19	33	-	3
CUW	7/7/19	7/20/19	13	-	1
IDN	9/20/19	10/7/19	17	-	1
IDN	NA	11/12/19	NA	-	1
JPN	10/12/19	10/25/19	13	-	2
LBR	1/9/19	1/30/19	21	-	2
LBR	12/17/18	1/8/19	22	2	-
LTU	7/22/19	8/2/19	11	-	1
PAN	1/16/19	3/8/19	51	-	1
PAN	3/8/19	5/14/19	67	-	1
PAN	6/28/19	9/4/19	68	-	2
PAN	9/20/19	10/10/19	20	-	1
PAN	10/27/19	11/25/19	29	-	1
PAN	11/8/19	2/14/20	98	-	2
PAN	11/25/18	4/15/19	141	-	3
THA	11/7/19	11/17/19	10	-	2
TWN	1/12/19	5/13/19	121	-	1
TWN	1/24/19	2/11/19	18	-	3